

DUWAMISH AND SOUTH AND BOTHELL SUBSURFACE

85-3

925.2 and 926.1



SEATTLE CITY LIGHT WORK ORDER #85-3

PCB SOIL TESTING AT THREE CITY LIGHT SUBSTATIONS:
BOTHELL, DUWAMISH, AND SOUTH

Raven Systems & Research Inc.

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Washington, D.C. • Boulder, Colorado • Pascagoula, Mississippi • Seattle, Washington

March 28, 1985



Ms. Kris Benson
Office of Environmental Affairs
Seattle City Light
1015 Third Avenue
Seattle, Washington 98104

Dear Kris:

Enclosed are the original and nine copies of the final report as authorized under SCL Work Order #85-3, "PCB Soil Testing at Three City Light Substations: Bothell, Duwamish, and South."

Please be advised that the sample locations are underneath the specified sampling positions from the Work Order #84-4 project. A key to the nomenclature has been included in the Bothell "Results" section of this report, to prevent confusion.

Sincerely yours,

Michael L. Healy, Ph.D.
Project Manager

MLH/sc

MAR 28 1985

Raven Systems & Research Inc.

Washington, D.C. • Boulder, Colorado • Pascagoula, Mississippi • Seattle, Washington

SEA036750



FINAL REPORT

SEATTLE CITY LIGHT WORK ORDER #85-3

PCB SOIL TESTING AT THREE CITY LIGHT SUBSTATIONS:
BOTHELL, DUWAMISH, AND SOUTH

Submitted by
Raven Systems & Research, Inc.
2200 Sixth Avenue, Suite 519
Seattle, Washington 98121

March 28, 1985



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SEATTLE CITY LIGHT WORK ORDER #85-3

PCB SOIL TESTING AT THREE CITY LIGHT SUBSTATIONS: BOTHELL, DUWAMISH, AND SOUTH

I. INTRODUCTION

In late January, 1985, Raven Systems & Research, Inc. undertook a project to determine the extent of PCB contamination under certain capacitor, transformer, and circuit breaker sites at the Duwamish and South Substations, [1000 Marginal Way South, and Fourth Ave. South & South Spokane, respectively]. Also included in this study was an investigation of the vertical extent of PCB contamination under the capacitor banks at Bothell substation [3912 156th Ave. Southeast in Snohomish County] subjected to historic spills, as determined in the report for the August 1984 study, under Work Order #84-4, "Soil Sampling to Test for PCB Contamination, Georgetown Steam Plant/Bothell Substation." Procedures were based on guidelines and protocols established in "Test Methods for Evaluating Solid Waste," USEPA SW-846 2nd ed. 1982. This document updates the guidelines published in the Federal Register, December 3, 1979.

II. METHODOLOGY

A. Sample Containers

All samples were placed in 250 ml wide-mouth glass containers that had been pre-cleaned. The metal screw cap lids were lined with aluminum foil such that the dull side was in contact with the sample.

The pre-cleaning procedure involved scrubbing with a special petrochemical dissolving soap [Allied Plumbing & Heating, Seattle]. The terminal end of the brush applied had sufficient bristles to scrub the seam where the side connects with the bottom. A final rinsing with methylene chloride was undertaken to remove any invisible greases and detergent residues.

The special tools are laboratory grade stainless steel. Digging tools, augers and earth drilling bits are high carbon tool steel.



Tools were cleaned with aforementioned detergent and rinsed with methylene chloride. The tools were buffed free of rust before arriving at the site.

B. Field Observations

Data on the collection process and observations of the physical nature of the sample were kept in the bound field log book. The format for this book is chronological.

C. Sampling Strategy

In accordance with EPA SW-846, sampling strategy was chosen from sections most analogous to the nature of the soil at the sites. These sections are "waste piles" [1.4.3] and "landfills" [1.4.4]. Individual decisions were required for each site with the purpose of the study in mind. Large cobbles, crushed rocks, and gravels greater than 1 cm in diameter were not included in the soil samples.

D. Sample Collection

Method 8080 in the EPA SW-846 manual describes the protocol for handling of organochlorine pesticides and polychlorinated biphenyls. Compliance with these instructions necessitated using glass containers and specified conditions for refrigeration. All samples in our case were delivered to the laboratory in time to comply with the maximum seven [7] days storage for extraction and thirty [30] days for complete analysis.

The compacted sand and gravel at the Bothell site was collected to 24" deep with a posthole digger. Samples in the drill holes where the auger could penetrate were removed by scraping off the last several turns on the bottom of the auger. These turnings were collected after cleaning as the desired depth was approached. The material directly above the desired depth was moved up the auger before the material to be sampled was penetrated. This process served to clean the last turnings of the auger that may have picked



up contaminated dust on the surface from re-entry into the drill hole. Also, the turnings at the bottom are protected during this exiting maneuver.

Soil samples at the Duwamish and South Substations were collected with the auger to the specified [6" or 8"] depth. These samples were composited in a precleaned pyrex glass mixing bowl and stainless steel spoon. A subsample of the mixture was spooned into the glass sample jar for each sample.

The sump sediment was sampled with a stainless steel trier [1 3/4" diameter]. The soil samples were obtained by drilling to 6" depths with a tool steel auger and confined in an inverted 1/2 gallon steel can. The concrete was sampled with tool steel star drills that produced fine chips and dust at the concrete surface. The resulting pits were 1/16" to 1/8" deep. Fifteen to twenty pits were nominally required at each sub-sample location. The chippings were collected in toto with a 6" wide acrylic brush and dust pan. All tools were cleaned between each compositing exercise. Descriptions of the collected samples can be found in Table IV.

E. Analysis

Samples, stored no longer than five [5] days at 4° c, were extracted with iso-octane using the Soxhlet extraction [USEPA Method 3540] procedures. The samples were analyzed by a modification of the packed column gas chromatography procedure described in Method 8080. The Arochlor species in the extracts were separated in a 25 meter capillary column.

III. RESULTS AND DISCUSSION: BOTHELL

A. Capacitor Bank Nomenclature

The designation of the gravel-filled sections between footings in the capacitor banks are as follows:

2nd Bay	1st Bay	Middle	1st Bay	2nd Bay	NORTH --->
South	South	Bay	North	North	



B. Results: See Table I and Figure 1B

Referring to the report of the previous study in August, 1984, under Work Order #84-4 one finds the PCB penetration of PCB in the south capacitor bank decreasing from a few ppm at the surface to less than 1 ppm at 16" depth. The results of this study [Table I] show no particular increase down to 24 inches except for the concentration of 12.6 ppm at 24" deep in the first bay south.

It should be noted that this location is one bay north of the analogous bay in the August study. The concrete deposit on the south bank contained 16.6 ppm PCB, mostly Arochlor 1242.

The north bank in the August, 1984 study was found to contain up to 260 ppm in the first bay south soil column at 16" depth, and 250 ppm in the second bay north soil column at 8" depth. Results from this study show no significant contamination in either the first bay south or the middle bay below 16" depth. The concrete composite on the north bank contained 76.0 ppm.

C. Discussion

The concern at the south bank may be with the "hot spot" that is 6800 ppm at the surface and 12.6 ppm at 24" depth with Arochlor 1242 consistently predominate. A mathematical linear decrease from a spill on top predicts the concentration would be zero at 24.04" depth. An exponential decrease:

$$C = 6800 e^{-0.26 (\text{depth in inches})}$$

yields a concentration of 2.85 ppm at 30" and 0.207 ppm at 40". These types of models, however, are inconsistent because of the presence of only 1.14 ppm for the 16" deep sample. The data from both studies indicate that one should not expect a systematic decrease in concentration with depth at these banks. The "hot spot" at 16" depth in the north bank [260 ppm, August, 1984] is then apparently isolated.



The data from all concurrent concrete studies show no apparent correlations between surface appearance and contamination. Green stains have three sources: 1) rainwash from copper ground wire connections; 2) green paint; and 3) moss or algae. Brown stains come from rust and soiling. Black stains come from oil and grease, not necessarily PCB contaminated. The rather high concentrations of the composites from the banks are suspected to be accumulations, rather than from one subsample containing 500-1000 ppm, although the latter is not impossible. These composites are a total of ten subsamples collected from ten of the twelve sampling sites.

Although the manhole vault (north bank, first bay north, west half) contained only 8 $\mu\text{g/l}$ PCB, the major Arochlor was 1242.

IV. RESULTS AND DISCUSSION: DUWAMISH

A. Results: See Table 2 and Figure[s] 1D and 2D

The capacitor bank environs contain less than 1 ppm PCB with Arochlor 1254 predominant. The transformer environs to the depths sampled have no contamination at present. The gravel disposal pile has little contamination in the four samples analyzed.

B. Discussion

Ongoing exchanges of gravel around the banks could have contributed to the near absence of PCB contamination. Of significance, however, is the low values found in the concrete composites. No residues apparently remain there. Had contaminated soil been removed, one would suspect higher results for the concrete and the gravel pile. The center of the pile could be contaminated, since the pile is 12' high and the drillholes [2 in each side and 2 in the top of each section] were 3' deep. The pile was 104' long and 43' wide. The sampling represents about half the volume of the pile. None of the data suggest contaminated soil lies inside. Although the rocks below the access valves of the transformers were heavily coated with black oils, no PCB was evident.



V. RESULTS AND DISCUSSION: SOUTH

A. Results: See Table 3 and Figure 1S, 2S, and 3S

Capacitor bank 947-3 shows contamination of 58.6 ppm in the sandy areas directly under the capacitors from 0"-6" depth. Capacitor bank 948 shows contamination of 129.6 ppm within the open metal foundations. Arochlor 1242 significantly predominates.

B. Discussion

The concentration of 9.3 ppm under capacitor bank 980 may be of concern if the contamination is from one subsample rather than additive from several. The breaker banks contained soils that appeared very oily from historic spills. No significant contamination, however, was in evidence from this study.



TABLE I
SEATTLE CITY LIGHT WORK ORDER #85-3
PCB SOIL TESTING AT THREE CITY LIGHT SUBSTATIONS:
BOTHELL, DUWAMISH, AND SOUTH

BOTHELL SAMPLE LISTINGS

<u>SAMPLE #</u>	<u>LOCATION</u>	<u>DEPTH [INCHES]</u>	<u>AROCHLOR RATIO 1242:1254:1260</u>	<u>CONCENTRATION [ppm dry weight]</u>
NORTH BANK:				
B-1	First Bay South	24	100:0:0	0.22
B-2	First Bay South	32	100:0:0	0.32
B-3	First Bay South	40	-----	*
B-4	Middle Bay	16	-----	*
B-5	Middle Bay	24	88:0:12	2.77
B-6	Middle Bay	32-36	-----	*
B-7	Middle Bay	41-46	-----	*
BR-2	Concrete	Surface	94:0:6	76.0
Slurry	Manhole	Surface	100:0:0	8 (ug/l)
SOUTH BANK:				
B-8	First Bay South	16	91:0:9	1.14
B-9	First Bay South	24	96:0:4	12.6
B-10	Second Bay North	16	-----	*
B-11	Second Bay North	24	-----	*
BR-1	Concrete	Surface	85:0:15	16.6

* below detection limit of 0.01 ppm [soil]



TABLE II
SEATTLE CITY LIGHT WORK ORDER #85-3
PCB SOIL TESTING AT THREE CITY LIGHT SUBSTATIONS:
BOTHELL, DUWAMISH, AND SOUTH

DUWAMISH SAMPLE LISTINGS

<u>SAMPLE #</u>	<u>LOCATION</u>	<u>DEPTH [INCHES]</u>	<u>AROCHLOR RATIO 1242:1254:1260</u>	<u>CONCENTRATION [ppm dry weight]</u>
D-1	Capacitor 830	2-8	0:0:100	0.17
D-2	Capacitor 830	Surface Concrete	0:100:0	0.02
D-3	Capacitor 827 East	2-8	0:100:0	0.07
D-4	Capacitor 827 West	2-8	0:100:0	0.41
D-5	Capacitor 827	Surface Concrete	0:100:0	0.26
D-6	Transformer 77	2-8	-----	*
D-7	Transformer 78	2-8	-----	*
D-8	Transformer 79	2-8	-----	*
D-9	Transformer 75	2-8	0:0:100	0.05
D-10	N.E. Field	2-8	-----	*
D-11	Blank	---	-----	Not analyzed
D-12	Pile face	0-40	0:100:0	0.08
D-13	Pile west	0-40	0:100:0	0.01
D-14	Pile east	0-40	-----	*
D-15	Pile back	0-40	0:100:0	0.03

* below detection of 0.01 ppm [soil]



TABLE III
SEATTLE CITY LIGHT WORK ORDER #85-3
PCB SOIL TESTING AT THREE CITY LIGHT SUBSTATIONS:
BOTHELL, DUWAMISH, AND SOUTH

SOUTH SAMPLE LISTINGS

SAMPLE #	LOCATION	DEPTH [INCHES]	AROCHLOR	CONCENTRATION [ppm dry weight]
			RATIO 1242:1254:1260	
S-1	Capacitor 947-3	0-6	92:2:6	58.6
S-2	Empty footings	0-6	33:0:67	0.06
S-3	Capacitor 947-1	0-12	27:20:53	0.30
S-4	Capacitor 408	0-6	-----	*
S-5	Capacitor 980	0-6	47:51:2	9.3
S-6	Capacitor 948	0-6	82:12:6	129.6
S-7	Breaker 2639	0-6	36:12:52	0.25
S-8	Breaker bank	0-6	7:7:86	0.14
S-9	Breaker 240-5 and 240-6	0-6	-----	*
S-10	Vacant Lot	0-6	-----	*
S-11	Blank	---	-----	*

* below detection limit of 0.01 ppm [soil]



TABLE IV

SEATTLE CITY LIGHT WORK ORDER #85-3
PCB SOIL TESTING AT THREE CITY LIGHT SUBSTATIONS:
BOTHELL, DUWAMISH, AND SOUTH

SAMPLE DESCRIPTIONS

<u>SAMPLE #</u>	<u>LOCATION</u>	<u>DESCRIPTION</u>
<u>BOTHELL - NORTH BANK:</u>		
B-1	First Bay South	At 15", struck gray clay
B-2	First Bay South	At 30", clay becomes sandy
B-3	First Bay South	Sandy clay
B-4	Middle Bay	At sand/clay interface
B-5	Middle Bay	Blue clay
B-6	Middle Bay	Blue clay
B-7	Middle Bay	Very blue clay/sand mix
BR-2	North Bank	Concrete composite [see below]
Slurry	Manhole	Water and rust-colored mud from flowing stream 2" deep at manhole bottom, 12' below bank; sample had appearance of raw sewage
<u>Concrete Subsample</u>		
1		Clear
2		Mottled old black stain
3		Green sheen + moss
4		Mottled black stain
5		Same as [4]
6		Green stain + buff paint
7		Old green patina
8		Same as [2]
9		Green sheen + moss
10		Same as [2]
11		Faint green sheen
12		Clear



<u>SAMPLE</u> <u>#</u>	<u>LOCATION</u>	<u>DESCRIPTION</u>
<u>BOTHELL - SOUTH BANK:</u>		
B-8	First Bay South	Pit run sand and rock
B-9	First Bay South	Blue clay/sand at 20"
B-10	Second Bay North	Rust-colored sand
B-11	Second Bay North	Hard buff sand/clay with gravels to 3/8" diameter
BR-1	South Bank	Concrete Composite
<u>Concrete Subsample</u>		
1		Green and rust sheen
2		Clear with green patina
3		Black coat
4		Green sheen
5		Same as [2]
6		Old black coat
7		Black coat
8		Clear
9		Green sheen + green paint
10		Green sheen + moss + paint
11		Same as [2]
12		Black smudge
<u>DUWAMISH:</u>		
D-1	Capacitor 830; soil	2" deep layer of fresh 1"-diameter cobbles; brown sand underneath, composite of 8
D-2	Capacitor 830; concrete	Composite of 8 subsamples; description in record
D-3	Capacitor 827; soil (east)	Topping of crushed rock to 1" diameter; composition below was dark brown sand/clay mix, composite of 6
D-4	Capacitor 827; soil (west)	Same as [D-3]
D-5	Capacitor 827; concrete	Composite of 8 subsamples; description in record
D-6	Transformer 77	Cobbles 2" in diameter mixed 50-50 with pea gravel to 1/2" diameter, composite of 4
D-7	Transformer 78	Top 2" cobbles coated with blue transformer paint and interspersed with "Absorbball"; brown clay underneath, composite of 4
D-8	Transformer 79	Cobbles to 3" diameter with black coating rocks; almost no sand/clay, composite of 4



<u>SAMPLE #</u>	<u>LOCATION</u>	<u>DESCRIPTION</u>
D-9	Transformer 75	Cobbles to 3" diameter with some fine pebbles to 1/8" diameter; randomly scattered "Absorball" particles, composite of 6
D-10	NE field	Composite of 5 samples for background; new gravel over brown sand
D-11	Blank; not analyzed	
D-12	Gravel pile; front face (west)	Composite of 4: brown fine sandy soil
D-13	Gravel pile; middle section (west)	Composite of 4: brown sandy soil mixed with packed crushed rock to 1" diameter
D-14	Gravel pile; middle section (east)	Composite of 4: same as [D-13]
D-15	Gravel pile; back side	Composite of 4: same as [D-13]
<u>SOUTH:</u>		
S-1	Capacitor 947-3	Topping of cobbles to 1 1/2" diameter in fine dark brown sand; sand mixed with cobbles to 1/2" diameter underneath, composite of 8
S-2	Empty capacitor bank footings	Same as [S-1] with more sand
S-3	Capacitor 947-1 (west)	Same as [S-1] except tan fine sand; south-east subsample had clay at 7" depth
S-4	Capacitor 408	Mostly tan sand with a few cobbles to 1 1/2" diameter, composite of 8
S-5	Capacitor 980	Topping of old crushed rock to 2" long with light brown sheen; no odors; brown sand below, composite of 8
S-6	Capacitor 948	Few crushed rocks mixed with fine dark brown sand, composite of 8
S-7	Breaker 2639	Topping of crushed rock to 3/4" above light brown sand with gravels to 1/4" diameter; noticeable black sheen but no odors detected, composite of 3
S-8	Composite along breaker bank	Topping of crushed rock to 2" long; dark brown sand below, composite of 8
S-9	Composite Breaker 240-5 240-6	2"-3" deep overlay of crushed rock to 1 1/2" long; wet gray sand/clay mix below; wood chips 9"-10" deep at 240-5, composite of 12
S-10	N. Central vacant lot	Background: old looking, crushed to 1" long with dark brown sand/clay mix underneath, composite of 5
S-11	Blank	Solvent in sample jar on site

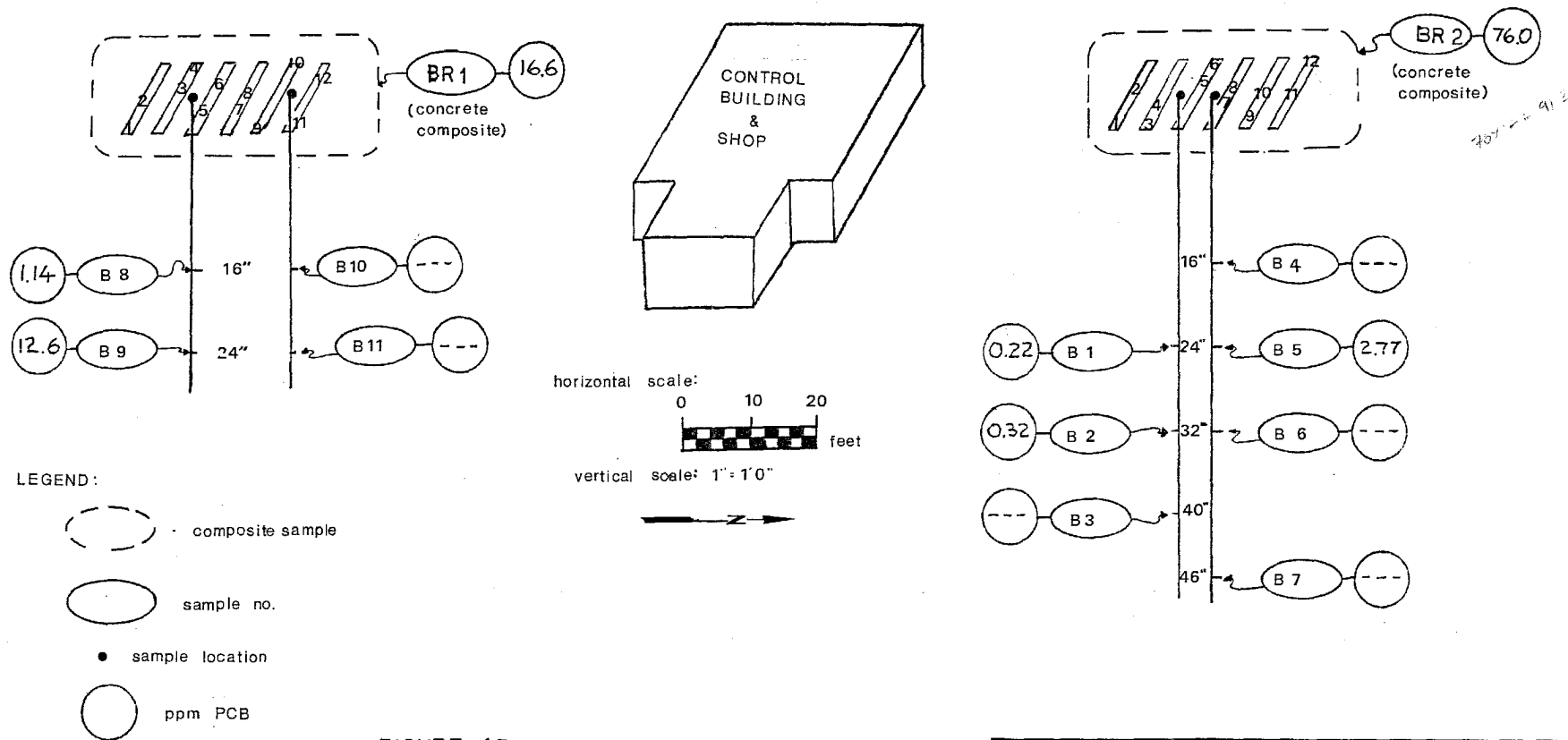


FIGURE 1B:
BOTHELL SUBSTATION
SAMPLE LOCATION & CONCENTRATION
(Isometric Projection)

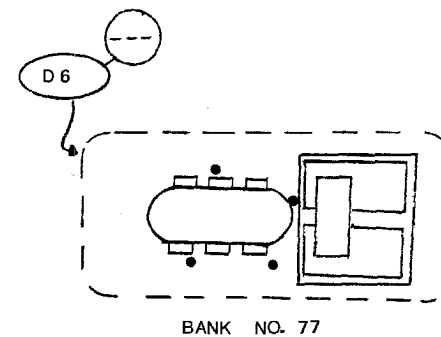
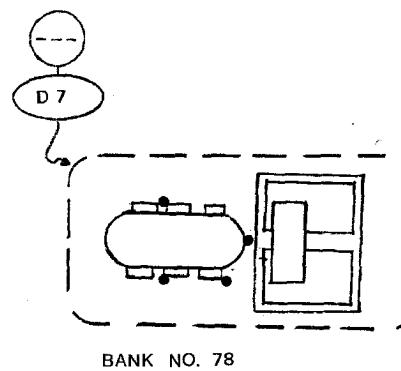
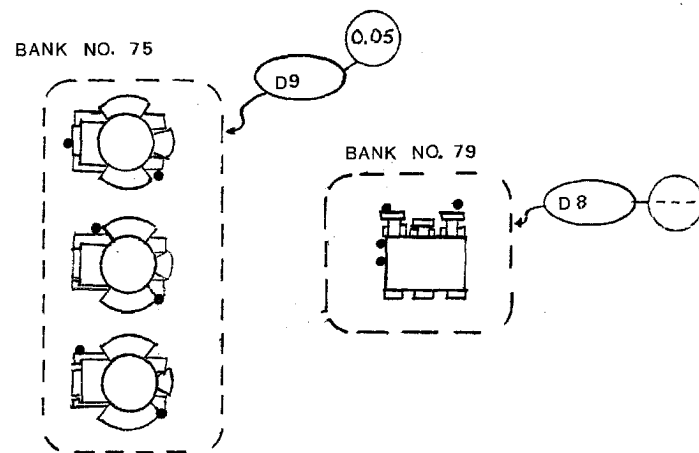
SAMPLING DATE 4 FEB. '85

RAVEN SYSTEMS and RESEARCH, INC		
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DATE: 7-III-85		REVISED JD
LA TERRE ENVIRONMENTAL CONS.		DRAWING NUMBER 85-3-1B

CONTROL
BUILDING
&
SHOP

FIGURE 1D:
DUWAMISH SUBSTATION
SAMPLE LOCATION
&
CONCENTRATION

SAMPLING DATE 5 FEB. '85



LEGEND:
● sample location ○ ppm PCB
○ composite sample no.



RAVEN SYSTEMS and RESEARCH, INC

SCALE: as shown

APPROVED BY:

DRAWN BY LSG

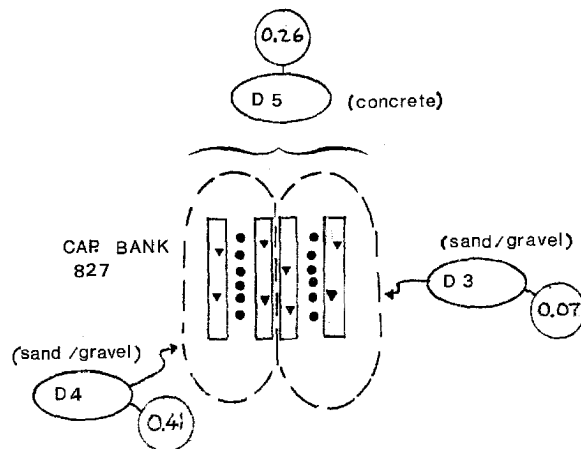
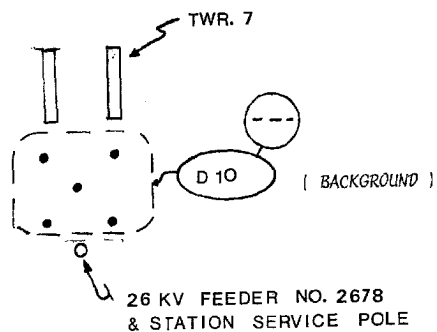
DATE: 7-III-85

MSH

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LA TERRE ENVIRONMENTAL CONS.

DRAWING NUMBER
85-3-1D



LEGEND:

- sand/gravel sample
- ▲ concrete sample

○ composite sample no.

○ ppm PCB

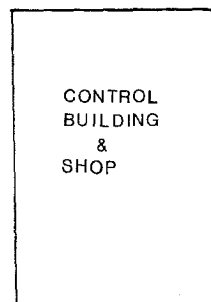
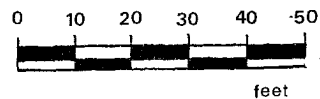
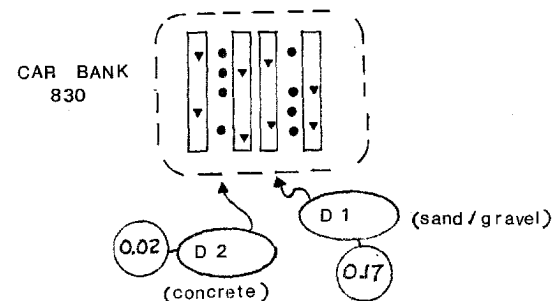


FIGURE 2D:)

DUWAMISH SUBSTATION

SAMPLE LOCATION & CONCENTRATION

SAMPLING DATE 31 JAN. '85



RAVEN SYSTEMS and RESEARCH, INC

SCALE: as shown

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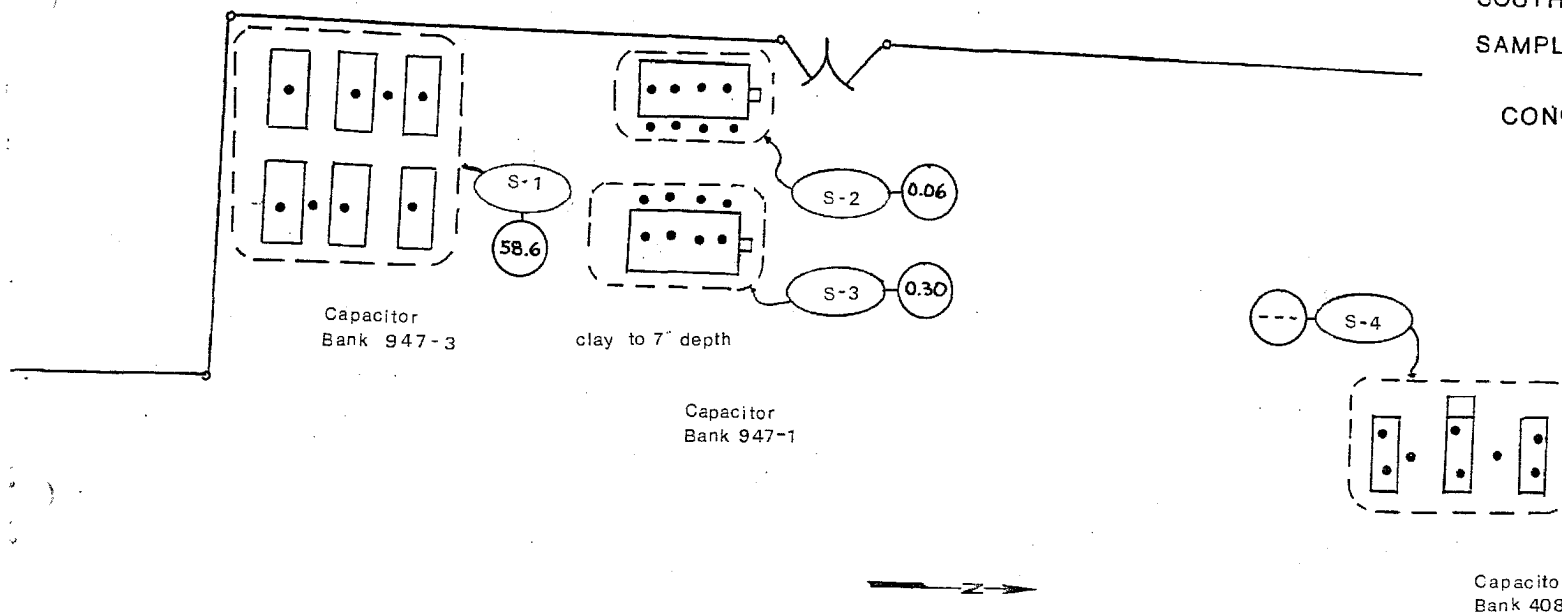
DATE 7-III-85

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DRAWING NUMBER
85-3-2D

FIGURE 1S:
SOUTH SUBSTATION
SAMPLE LOCATION
&
CONCENTRATION



LEGEND:

• Sample location

○ Composite sample no.

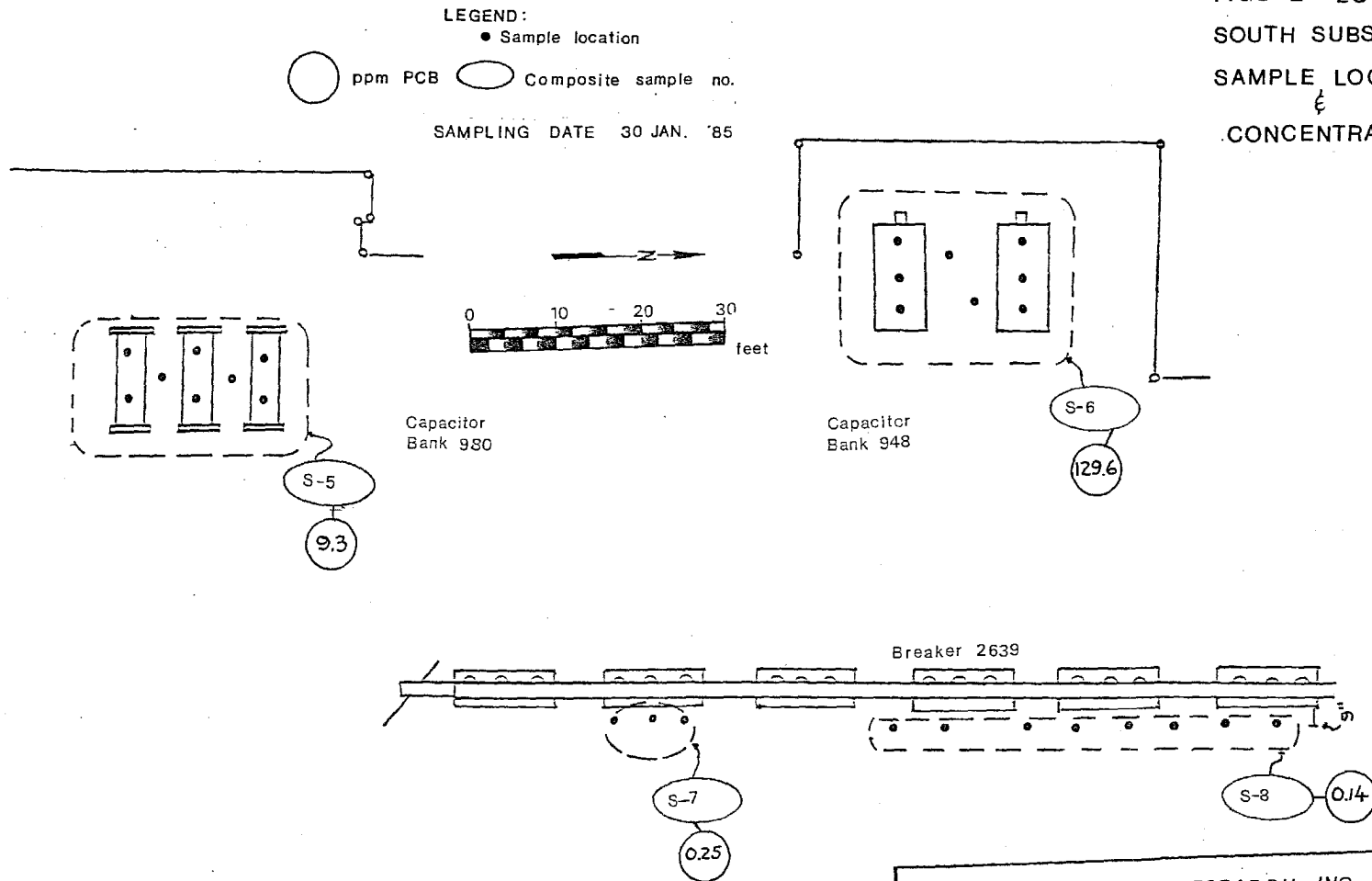
○ ppm PCB

0 10 20 30 feet

SAMPLING DATE 30 JAN. '85

RAVEN SYSTEMS and RESEARCH, INC		
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DATE 7-III-85		REVISED JD
LA TERRE ENVIRONMENTAL CONS.		
		DRAWING NUMBER 85-3-1S

FIGURE 2S:
SOUTH SUBSTATION
SAMPLE LOCATION
&
CONCENTRATION



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LA TERRE ENVIRONMENTAL CONS.		DRAWING NUMBER 85-3-25

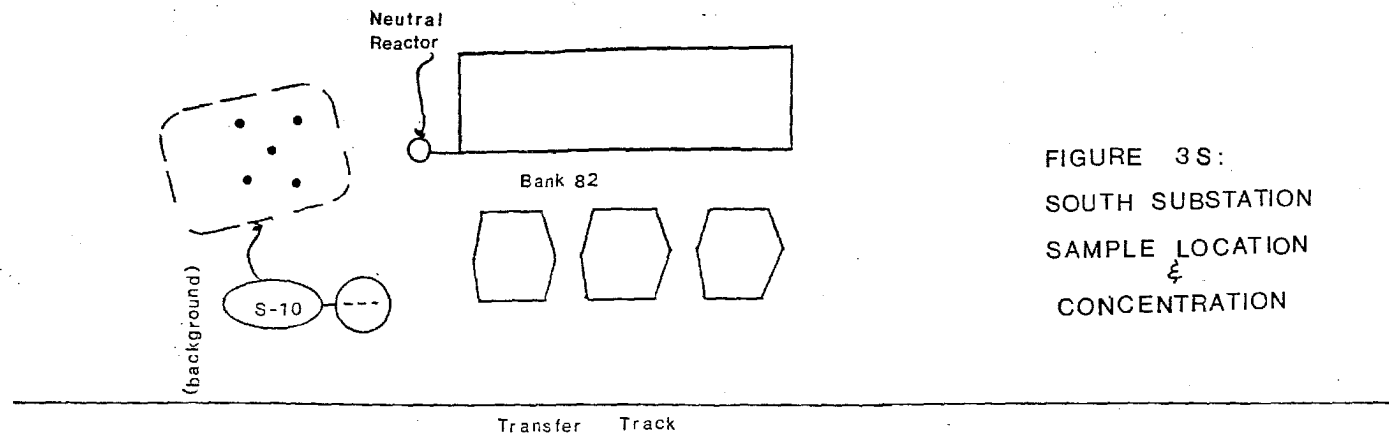


FIGURE 3S:
SOUTH SUBSTATION
SAMPLE LOCATION
&
CONCENTRATION

